Intrinsic Resolution of Jet Finding in the LHC Environment

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The ALICE-USA collaboration has previously demonstrated [1] that event-by-event jet finding will be possible in the heavy-ion environment at LHC energies. The benefit of reconstructing jets event-by-event is that it will allow the construction of a jet fragmentation function. This observable is considered to be most sensitive to the effects of medium-induced jet energy loss (jet-quenching). Due to the fact that the energy distribution within the cone is not expected to differ for the quenched and unquenched case[2], the effectiveness of pure calorimetric studies of jets is negligible. The fragmentation function, however, is expected to be softened. Modifications of particle distributions perpendicular to the jet-direction will be another sensitive observable. Experiments exhibiting good tracking will be most effective at measuring the effects of jet-quenching.

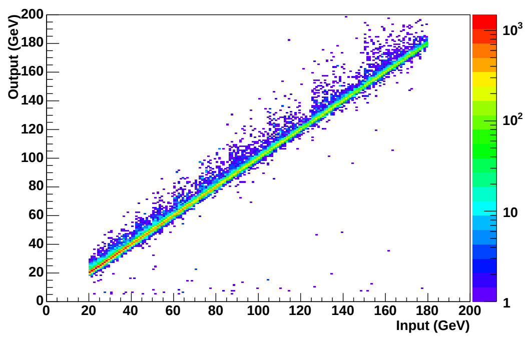

FIG. 1: Correlation between PYTHIA jet reconstruction and ALICE-USA jet reconstruction. The x-axis shows the input jet energy as determined by PYTHIA and the y-axis show our reconstructed jet energy.

To determine the algorithm resolution we need a reference. PYTHIA [3] incorporates a k_T-clustering algorithm which acts on the entire PYTHIA event finding jet-like structures in the final event products. As this algorithm is related to the jet definition we chose the results of this algorithm as our reference.

Jet particles are defined to be contained in a cone of 1 radian with all tracks included. Implementing our algorithm [4] with a cone radius of 1 and no background subtraction or p_T-cut acting on all track information, neutral and charged, is the most unrestricted case. The comparison of the results of this unrestricted case with the results of PYTHIA jet finding are shown in figure 1. It is clear from the plot that we are able accurately reproduce PYTHIA's jet reconstruction.

In reality the ALICE detector will have no calibrated way of measuring the energy of neutrons, K_L and neutrinos. All other particles are expected to leave their energy in some measurable way, either by direct interaction or through the interactions of decay products.

Figure 2 shows, in the top panel, the effect of discarding this truly neutral energy on the resolution of the reference. The effect is quite substantial and forms part of the intrinsic physics resolution of the experiment.

In the bottom panel of figure 2 the effect of further imposing the cuts which are needed to optimise the resolution[1] in the heavy-ion environment are shown. It is clear that the best possible resolution of jet finding in the heavy ion environment is heavily dependent on the choice of cuts and how this restricts the information that can be reconstructed.

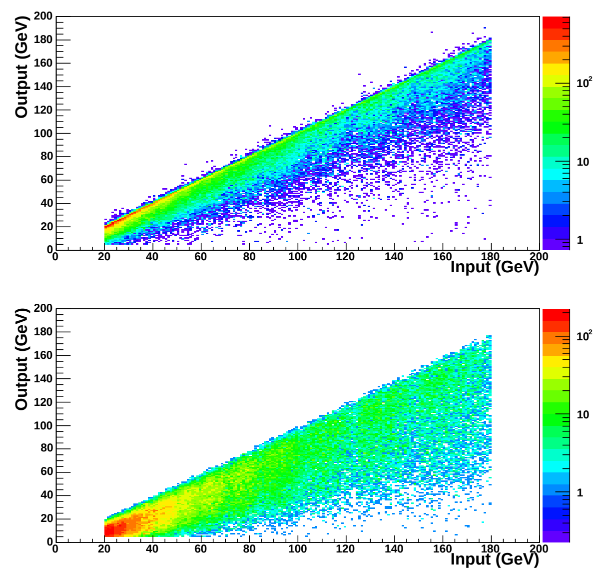

FIG. 2: The top panel shows the effects of neutral energy loss and the bottom panel shows the further effects of cone radius and p_T cuts. In both plots the x-axis is input jet energy and the y-axis is reconstructed jet energy

We have studied the precise contributions to the resolution of jet finding at the LHC and the limitations imposed by the heavy-ion environment. This, as well as knowing precisely the instrument function for each of the components in ALICE, will allow us to reconstruct well calibrated fragmentation functions to compare with the pp reference also taken in ALICE.

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[3] T. Sjostrand, Computer Physics Commun. **135**, 238 (2001).
[4] S.-L. B. et al., contained in this report (2004).